PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
IPD/P2352/WOD		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 00/ 00210	25/01/2000	28/01/1999

Applicant

THE SECRETARY OF STATE FOR DEFENCE et al.

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of th **drawings** to be published with th abstract is Figure No. _____

   [ ] as suggested by the applicant.

   [ ] because th applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [X] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/00210

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G08B17/117 G01N27/64 G08B17/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G08B G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 691 783 A (STERN GEOFFREY S ET AL) 8 September 1987 (1987-09-08) the whole document	1,2
A	EP 0 795 749 A (BRUKER SAXONIA ANALYTIK GMBH) 17 September 1997 (1997-09-17) the whole document	1,2,5,6, 12-16
A	US 5 294 794 A (DAVIES DAVID K) 15 March 1994 (1994-03-15) the whole document	1,12
A	US 5 405 781 A (DAVIES JOHN H ET AL) 11 April 1995 (1995-04-11) the whole document	1,12

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 April 2000	12/04/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Kelperis, K

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
T/GB 00/00210

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4691783 A	08-09-1987	NONE	
EP 0795749 A	17-09-1997	DE 19609582 C	28-05-1997
		US 5968837 A	19-10-1999
US 5294794 A	15-03-1994	NONE	
US 5405781 A	11-04-1995	CA 2132607 A	22-03-1995
US 5162652 A	10-11-1992	NONE	
EP 0401861 A	12-12-1990	US 4987767 A	29-01-1991
		AT 153131 T	15-05-1997
		AU 633582 B	04-02-1993
		AU 5690590 A	13-12-1990
		CA 1329494 A	17-05-1994
		CA 2018697 A	09-12-1990
		DE 69030686 D	19-06-1997
		DK 401861 T	03-11-1997
		ES 2102355 T	01-08-1997
		GR 3024358 T	28-11-1997
		IL 94684 A	29-12-1994
		IL 107672 A	15-03-1995
		JP 2119373 C	06-12-1996
		JP 3087629 A	12-04-1991
		JP 8033338 B	29-03-1996
		JP 2610118 B	14-05-1997
		JP 7209151 A	11-08-1995
		KR 9409049 B	29-09-1994
		US 5465607 A	14-11-1991
		US 5585575 A	17-12-1996
		US 5345809 A	13-09-1994
		AT 182406 T	15-08-1999
		AU 679387 B	26-06-1997
		AU 3063495 A	09-11-1995
		AU 7032291 A	18-07-1991
		CA 2070648 A	09-06-1991
		CA 2229011 A	09-06-1991
		DE 69033217 D	26-08-1999
		DE 69033217 T	09-12-1999
		EP 0502998 A	16-09-1992
		EP 0881479 A	02-12-1998
		EP 0881482 A	02-12-1998
		EP 0881480 A	02-12-1998
		EP 0905501 A	31-03-1999
		ES 2134192 T	01-10-1999
		IE 80621 B	21-10-1998
		IL 96605 A	21-10-1994
		JP 9126964 A	16-05-1997
		JP 9126965 A	16-05-1997
		JP 9126966 A	16-05-1997
		JP 2814304 B	22-10-1998
		KR 171421 B	01-05-1999
		WO 9109307 A	27-06-1991
		US 5109691 A	05-05-1992

From the
INTERNATIONAL PRELIMIN[redacted]EXAMINING AUTHORI

FAX Mike Cassidi
[redacted]02392 336098
[redacted]Mara Burrell
formalities f/b
06 16/05/2001

T :

BOWDERY Anthony Oliver
D/IPR DERA Formalities
A4 Bldg Ively Road
FARNBOROUGH
Hampshire
GU 14 OLX
GRANDE BRETAGNE

THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing *(day/month/year)* 03.05.2001

Applicant's or agent's file reference
IPD/P2352/WOD

IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/00210	25/01/2000	28/01/1999

Applicant
THE SECRETARY OF STATE FOR DEFENCE et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

CPI UPDATED 09/05/01

Name and mailing address of the IPEA/

European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized officer

Atienza Vivancos, B

Tel.+49 89 2399-7891

Form PCT/IPEA/416 (July 1992)

13

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
IPD/P2352/WOD		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/00210	25/01/2000	28/01/1999
International Patent Classification (IPC) or national classification and IPC G08B17/117		
Applicant THE SECRETARY OF STATE FOR DEFENCE et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
30/06/2000	03.05.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Van der Zee, C Telephone No. +49 89 2399 2441

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00210

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-7 as originally filed

Claims, No.:

1-16 as originally filed

Drawings, sheets:

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	
	No:	Claims	1, 11-15
Inventive step (IS)	Yes:	Claims	
	No:	Claims	2-10, 16
Industrial applicability (IA)	Yes:	Claims	1-16
	No:	Claims	

2. Citations and explanations
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

1. Although claims 1 and 15 and claims 11-14 have been drafted as separate in- dependent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack concise- ness, Article 6 PCT. Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims places an undue burden on others seeking to establish the extent of the protection, Article 6 PCT.

2. The method claimed in claim 1 is known from EP-A-0 795 749 (D2), see in particular page 2 lines 31-33. This passage discloses use of an ion mobility spectrometer for the detection of explosives, which in actual fact of course constitute a risk of the onset of fire. Claim 1 just claims "under conditions at which there is a risk of the onset of fire". Claim 1 thus lacks the required novelty, Article 33(2) PCT.

3. It is not considered useful to amend claim 1 so as to claim "conditions at which there is a risk of the onset of fire excluding conditions caused by the presence of explosives", for two reasons. One is that such subject matter has not been originally disclosed in the present application. Such an amendment would thus contravene Article 19(2) PCT. The other is that it would not be possible, technically, to exclude detection of such gases with an ion mobility spectrometer as described. Such an amendment would thus contravene Articles 33(1) and (4) PCT.

4. The facilities claimed in claim 2 are facilities well-known to require an early warning for any risk of the onset of fire. Thus claim 1 lacks the required inventive step, Article 33(3) PCT.

5. Claims 3 - 6 claim the trivial alternative requirements for any effective detection of a risk of fire and thus these claims do not meet the requirement of Article 33(3) PCT.

6. Claim 7 claims a well-known criterium for any alarm detection where the measured value is subject to some insignificant variation and thus claim 7 does not meet the requirement of Article 33(3) PCT.

7. Claim 8 is not clear, Article 6 PCT. It is not clear whether the claimed detection of features is a detection of **particular** gases and if so, how this should be done. The description page 3 lines 24 - 28 is not helpful in this respect (Article 5 PCT). The feature claimed in claim 8 might even be interpreted as **not** requiring any gas sampling for the ion mobility spectrometer.

8. Claims 9 and 10 are not clear, Article 6 PCT. It is not clear in how far the volatile material released from an electrical component may specifically be defined. It is also not clear how the skilled person may realize the feature in some specific manner having regard to the description, as page 3 lines 24 - 28 is not helpful in this respect (Article 5 PCT).

9. Claims 11 - 15 do not meet the requirements of the PCT for the various reasons given above.

10. The feature claimed in claim 16 would not be useful in formulating any new independent claim for the reason given in regard of claim 7.

09/889639

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

BOWDERY, A., O.
D/IPD
Formalities Section
Poplar 2, MOD Abbey Wood #19
Bristol BS34 8JH
ROYAUME-UNI

Date of mailing (day/month/year)
23 August 2001 (23.08.01)

Applicant's or agent's file reference
IPD/P2352/WOD

IMPORTANT NOTIFICATION

International application No.
PCT/GB00/00210

International filing date (day/month/year)
25 January 2000 (25.01.00)

1. The following indications appeared on record concerning:

[ ] the applicant [ ] the inventor [X] the agent [ ] the common representative

Name and Address
BOWDERY, A., O.
D/IPR
DERA Formalities
A4 Bldg, Ively Road
Farborough
Hampshire GU14 OLX
United Kingdom

State of Nationality:
State of Residence:
Telephone No.: 0117 9132860
Facsimile No.: 0117 9132930
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address
BOWDERY, A., O.
D/IPD
Formalities Section
Poplar 2, MOD Abbey Wood #19
Bristol BS34 8JH
United Kingdom

State of Nationality:
State of Residence:
Telephone No.: 0117 91 32857
Facsimile No.: 0117 91 32930
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
Marie Victoria CORTIELLO

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

BOWDERY, A., O.
D/IPD
Formalities Section
Poplar 2, MOD Abbey Wood #19
Bristol BS34 8JH
ROYAUME-UNI

Date of mailing (day/month/year)
21 August 2001 (21.08.01)

Applicant's or agent's file reference
IPD/P2352/WOD

IMPORTANT NOTIFICATION

International application No.
PCT/GB00/00210

International filing date (day/month/year)
25 January 2000 (25.01.00)

1. The following indications appeared on record concerning:

[ ] the applicant [ ] the inventor [X] the agent [ ] the common representative

Name and Address
BOWDERY, A., O.
D/IPR
DERA Formalities
A4 Bldg, Ively Road
Farborough
Hampshire GU14 OLX
United Kingdom

State of Nationality:
State of Residence:
Telephone No.: 0117 9132860
Facsimile No.: 0117 9132930
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address
BOWDERY, A., O.
D/IPD
Formalities Section
Poplar 2, MOD Abbey Wood #19
Bristol BS34 8JH
United Kingdom

State of Nationality:
State of Residence:
Telephone No.: 0117 91 32857
Facsimile No.: 0117 91 32930
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

Authorized officer
CORTIELLO Maria Victoria
Telephone No.: (41-22) 338.83.38

09/889639

P ENT COOPERATION TREA

From the INTERNATIONAL BUREAU

PCT

To:

SKELTON, Stephen, Richard
D/IPR Formalities Section
Poplar 2
MOD Abbey Wood #19
Bristol BS34 8JH
ROYAUME-UNI

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

Date of mailing (day/month/year) 14 September 2001 (14.09.01)	
Applicant's or agent's file reference IPD/P2352/WOD	**IMPORTANT NOTIFICATION**
International application No. PCT/GB00/00210	**International filing date** (day/month/year) 25 January 2000 (25.01.00)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address	State of Nationality	State of Residence
THE SECRETARY OF STATE FOR DEFENCE CBD Porton Down Salisbury Wilts SP4 0JQ United Kingdom United Kingdom	GB	GB
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address	State of Nationality	State of Residence
THE SECRETARY OF STATE FOR DEFENCE DSTL Porton Down Salisbury Wiltshire SP4 0JQ United Kingdom	GB	GB
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer S. Buttay
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Copy for the designated Office (DO/US)

PCT/GB00/00210

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

BOWDERY, A., O.
D/IPR
DERA Formalities
A4 Bldg, Ively Road,
Farborough
Hampshire GU14 OLX
ROYAUME-UNI

Date of mailing (day/month/year)
29 August 2000 (29.08.00)

Applicant's or agent's file reference
IPD/P2352/WOD

IMPORTANT NOTIFICATION

International application No.
PCT/GB00/00210

International filing date (day/month/year)
25 January 2000 (25.01.00)

1. The following indications appeared on record concerning:

☐ the applicant ☐ the inventor ☒ the agent ☐ the common representative

Name and Address
BOWDERY, A., O.
D/IPR
Formalities Section
Poplar 2, MOD Abbey Wood #19
Bristol BS34 8JH
United Kingdom

State of Nationality

State of Residence

Telephone No.
0117 91 32857

Facsimile No.
0117 91 32930

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address
BOWDERY, A., O.
D/IPR
DERA Formalities
A4 Bldg, Ively Road,
Farborough
Hampshire GU14 OLX
United Kingdom

State of Nationality

State of Residence

Telephone No.
01252 392722

Facsimile No.
01252 393920

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☐ the International Preliminary Examining Authority
☒ the designated Offices concerned
☐ the elected Offices concerned
☐ other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
Lazar Joseph Panakal

Telephone No.: (41-22) 338.83.38

Form PCT/IB/306 (March 1994)

003493765

PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

Date of mailing (day/month/year) 29 August 2000 (29.08.00)	
International application No. PCT/GB00/00210	**Applicant's or agent's file reference** IPD/P2352/WOD
International filing date (day/month/year) 25 January 2000 (25.01.00)	**Priority date** (day/month/year) 28 January 1999 (28.01.99)
Applicant FOULGER, Brian et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

30 June 2000 (30.06.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Lazar Joseph Panakal

Telephone No.: (41-22) 338.83.38

INTERNATIONAL SEARCH REPORT

Inter. Application No
PCT/GB 00/00210

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G08B17/117 G01N27/64 G08B17/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G08B G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 691 783 A (STERN GEOFFREY S ET AL) 8 September 1987 (1987-09-08) the whole document	1,2
A	EP 0 795 749 A (BRUKER SAXONIA ANALYTIK GMBH) 17 September 1997 (1997-09-17) the whole document	1,2,5,6, 12-16
A	US 5 294 794 A (DAVIES DAVID K) 15 March 1994 (1994-03-15) the whole document	1,12
A	US 5 405 781 A (DAVIES JOHN H ET AL) 11 April 1995 (1995-04-11) the whole document	1,12

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 April 2000	12/04/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Kelperis, K

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/00210

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 162 652 A (COHEN MARTIN J ET AL) 10 November 1992 (1992-11-10) the whole document	1,12
A	EP 0 401 861 A (RES CORP TECHNOLOGIES INC) 12 December 1990 (1990-12-12) the whole document	1,12

Information on patent family members

Inter[illegible]al Application No
PCT/GB 00/00210

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4691783 A	08-09-1987	NONE	
EP 0795749 A	17-09-1997	DE 19609582 C	28-05-1997
		US 5968837 A	19-10-1999
US 5294794 A	15-03-1994	NONE	
US 5405781 A	11-04-1995	CA 2132607 A	22-03-1995
US 5162652 A	10-11-1992	NONE	
EP 0401861 A	12-12-1990	US 4987767 A	29-01-1991
		AT 153131 T	15-05-1997
		AU 633582 B	04-02-1993
		AU 5690590 A	13-12-1990
		CA 1329494 A	17-05-1994
		CA 2018697 A	09-12-1990
		DE 69030686 D	19-06-1997
		DK 401861 T	03-11-1997
		ES 2102355 T	01-08-1997
		GR 3024358 T	28-11-1997
		IL 94684 A	29-12-1994
		IL 107672 A	15-03-1995
		JP 2119373 C	06-12-1996
		JP 3087629 A	12-04-1991
		JP 8033338 B	29-03-1996
		JP 2610118 B	14-05-1997
		JP 7209151 A	11-08-1995
		KR 9409049 B	29-09-1994
		US 5465607 A	14-11-1991
		US 5585575 A	17-12-1996
		US 5345809 A	13-09-1994
		AT 182406 T	15-08-1999
		AU 679387 B	26-06-1997
		AU 3063495 A	09-11-1995
		AU 7032291 A	18-07-1991
		CA 2070648 A	09-06-1991
		CA 2229011 A	09-06-1991
		DE 69033217 D	26-08-1999
		DE 69033217 T	09-12-1999
		EP 0502998 A	16-09-1992
		EP 0881479 A	02-12-1998
		EP 0881482 A	02-12-1998
		EP 0881480 A	02-12-1998
		EP 0905501 A	31-03-1999
		ES 2134192 T	01-10-1999
		IE 80621 B	21-10-1998
		IL 96605 A	21-10-1994
		JP 9126964 A	16-05-1997
		JP 9126965 A	16-05-1997
		JP 9126966 A	16-05-1997
		JP 2814304 B	22-10-1998
		KR 171421 B	01-05-1999
		WO 9109307 A	27-06-1991
		US 5109691 A	05-05-1992

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 :
G08B 17/117, G01N 27/64, G08B 17/10 — A1

(11) International Publication Number: **WO 00/45354**

(43) International Publication Date: 3 August 2000 (03.08.00)

(21) International Application Number: PCT/GB00/00210

(22) International Filing Date: 25 January 2000 (25.01.00)

(30) Priority Data:
9901764.2 28 January 1999 (28.01.99) GB

(71) Applicant *(for all designated States except US)*: THE SECRETARY OF STATE FOR DEFENCE [GB/GB]; Defence Evaluation and Research Agency, Ively Road, Farnborough, Hampshire GU14 0LX (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: FOULGER, Brian [GB/GB]; DERA Haslar, Gosport, Hants PO12 2AG (GB). RICHES, James [GB/GB]; DERA Haslar, Gosport, Hants PO12 2AG (GB). BOLLAN, Hilary, Roberta [GB/GB]; DERA Haslar, Gosport, Hants PO12 2AG (GB).

(74) Agent: BOWDERY, A., O.; D/IPR, Formalities Section, Poplar 2, MOD Abbey Wood #19, Bristol BS34 8JH (GB).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: FIRE DETECTION METHOD

(57) Abstract

A method for detecting gases or vapours emitted from materials, such as electrical components, under conditions at which there is a risk of the onset of fire, said method comprising sampling gas from the region of the material using an ion mobility spectrometer tuned to detect specific volatilised materials. The signal can be used to determine a fire risk and to trigger alarms as necessary. The method provides rapid detection with high sensitivity and high selectivity so as to minimise false alarms. Apparatus for use in the method is also described and claimed.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

Fire Detection Method

The present invention relates to a method for the detection of overheating of materials in particular electrical equipment, which precedes the onset of fire, as well as to apparatus for use in the method. Thus the invention is useful in providing advance warning of conditions likely to lead to fire so that preventative action can be taken.

Early warning fire detectors often rely on the detection of smoke particles to trigger an alarm. At this stage, fire is imminent if not already underway and so it is generally too late for preventative action.

Methods for the early detection of fire based upon the vapour detection have also been described. These have potential to provide advanced warning of an imminent fire. These chemical sensing techniques are often based on chemical coatings which interact with the outgassing vapours either through a chemical reaction (USP 5065140) or adsorption. In the former case, the detector lacks versatility in that it reacts only to the vapour of interest. The latter method lacks specificity and requires considerable signal processing effort.

Ion mobility spectrometers are well known in the detection of chemical warfare agents, explosives, propellants, and industrial pollutants. The principles by which they operate and the design of spectrometers are described for example by W. Carr (Ed). "Plasma Chromatography", Plenum Press, London, 1984, and Turner et al., Trends in Analytical Chemistry, 13, 7 (1994) 275-280. In essence, an ion mobility spectrometer consists of an ionisation region coupled to an ion drift tube via a shutter grid. A sample is introduced into the ionisation region together with a carrier gas (such as air), for example using a suction pump. In the ionisation region, the carrier gas molecules (as well as any sample) are ionised

by beta radiation from a Ni-63 radioactive source, or other methods such as corona discharge or photoionisation. Reactant ions are produced from the carrier gas (such as air) which react with the sample gas, generally in a complex manner, so as to result in product ions. Under the influence of an applied electric field, reactant and product ions are extracted from the ionisation region into the ion drift region. In the ion drift region, the ions separate due to their different mobilities determined by their size, charge and polarisability. They are collected at a collector electrode where they are neutralised, and so generate an electric current that can be measured. Data is generated at a rapid rate. Repeat scans are suitably averaged to improve the signal to noise ratio.

The spectrometer can be arranged to detect either positive or negative ions by reversal of the voltages.

The present invention provides a method for detecting gases or vapours emitted from materials under conditions at which there is a risk of the onset of fire, said method comprising sampling gas from the region of the material using an ion mobility spectrometer, detecting the ion peaks of volatilised material.

The advantages of the use of ion mobility spectrometry in this application are associated with its extreme sensitivity and selectivity. The spectrometer can be pre-set, by controlling the potentials applied to the drift region for example, so as to detect selected target gases which are emitted during outgassing through heating in any specific environment. The selectivity of the device means that it could be applied to a variety of different environments. However, it will be particularly useful in high technology environments, such as data processing and computer facilities, telephone exchanges, space stations, industrial plants especially chemical plants

or plants which deal with inflammable materials, where the risk of fire as a result of overheating devices and in particular electrical components is high, and the consequences of such a fire are extreme in economic terms at least.

Sampling can take place either continuously or at intervals, for example at pre-set intervals. Preferably, the sampling will be carried out continuously, as this allows an increasing signal, produced as a result of increased outgassing of a particular gas from the materials, for example as the temperature rises, to be detected against background noise levels.

The spectrometer may be connected to a warning or alarm system that may be triggered automatically, using various predetermined parameters. For example, if a signal peak reaches a particular intensity, this may trigger the alarm. An alternative, particularly suitable with continuous monitoring, would be to arrange for the alarm to be triggered when any signal peak increases significantly over a period of time. This may be indicative of a rise in temperature of the component that gives rise to the particular gas or vapour.

The alarm may be connected to the detection of features characteristic of thermal degradation and not just simple over-heating of components. This would ensure that only potentially serious situations resulted in an actual alarm, reducing false positives to a minimum.

The levels and the parameters used to trigger the alarm will vary depending upon the particular circumstances in which the spectrometer is being employed. Again, these can be determined using routine methods and the control systems designed appropriately.

There is no need to know or analyse the materials which are emitted, provided it can be ensured that at least some of these fall within the detection range set on the ion mobility spectrometer. This can be done by routine methods. For example, one or more representative components present in the particular environment to be monitored can be heated under safe test conditions and the signal generated as a result of the emission of material monitored. The detection range of the ion mobility spectrometer can then be adjusted to ensure a signal is generated under these conditions.

The spectrometer will be pre-set to detect either positive or negative ions depending upon the nature of the signal in each case. Selection of the most sensitive signal in each particular case can be determined, again by routine methods.

Many solid materials that release volatile material when heated, but in particular are electrical components such as printed circuit boards, resistors and lacquer-coated materials. The spectrometer will suitably be set to detect vapours emitted from such components.

Available ion mobility spectrometers are convenient to use in that it is small and hand-held. For use in the context of the invention however, size and portability may be less critical. The spectrometer may be installed in the environment on a permanent basis. It would not, under these circumstances be required to be as robust as a device which is intended, for example to be carried onto a battle-field. This may result in cost savings in the spectrometer itself.

In a further aspect the invention provides apparatus for detecting a heightened fire risk in an environment using the method as described above.

In particular, the apparatus will comprise an ion mobility spectrometer. The spectrometer is suitably adapted such that it is able to detect increases in the particular gases or vapours emitted from materials present in the particular environment in which it is placed, under conditions at which there is a heightened risk of the onset of fire. In particular, the controls of the device will be pre-set so that they are able to detect specific volatile materials likely to be emitted from materials present in the particular environment, which presents a potential fire hazard.

The precise settings of the controls of the spectrometer will vary depending upon the particular environment being monitored and can be determined by the skilled person using routine methods. Typically the electric field applied to the drift tube of the device will be in the range of from 150 to 350V/cm, more usually from 200 to 300V/cm and often at about 250V/cm. The frequency of spectrometer readings necessary to provide a rapid, detectable signal will depend to some extent, on the ion drift times of the particular volatile materials being detected. Generally, these are less than 20ms, and so spectra may be gathered at the rate of between 40 to 60 Hz, for example at about 50Hz.

Thus in a particular embodiment of the invention, there is provided an ion mobility spectrometer for use, or when used, in the method described above.

Yet a further aspect of the invention provides the use of an ion mobility spectrometer for the detection of a heightened risk of fire in an environment. More particularly, there is provided, the use of an ion mobility spectrometer in the detection of gases or vapours emitted from materials under conditions at which there is a risk of the onset of fire.

The invention will now be particularly described by way of example with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a schematic diagram of an ion mobility spectrometer;

Figure 2 shows the positive ion mobility spectra for a heated lacquer-coated printed circuit board at temperatures of from 50 to 85°C;

Figure 3 shows the positive ion mobility spectra for a heated lacquer-coated printed circuit board at temperatures of from 85 to 105°C;

Figure 4 shows the negative ion mobility spectra for a resistor heated to 50 to 100°C; and

Figure 5 shows the positive ion mobility spectra for a resistor heated to 50 to 100°C.

The illustrated device in Figure 1 comprises an inlet system comprising a heated nozzle (1) and a silicon rubber membrane (2). Gas sample is admitted through the inlet system as a result of the action of a diaphragm pump (3) operated by a motor (4). Sample transfers into an ionisation section (5) where a nickel-63 ion source generates the ions. A pulse of ions (generally about 0.2ms) is admitted into a drift tube section (6) by manipulation of the potentials on a grid assembly (7). The drift tube (6) is typically about 4cm long with an electric field of 250V/cm. Ions pass to a collector electrode (8), where they are neutralised, generating a current which is passed to a microprocessor (9), which generates a signal, if necessary after amplification. The signal may be passed to a display assembly (10).

In general ion drift times are less than 20ms, and so spectra may be gathered at the rate of say 50Hz.

Example 1

A lacquer coated printed circuit board was heated from 50 to 105°C in the vicinity of an ion mobility spectrometer that was operational throughout. At the start of the heating process, the positive reactant ion peak (i.e. that produced as a result of the ionisation of air), is the major feature of the spectrum (see Figure 2 - trace at the back of the representation). As the printed circuit board was heated, this peak is replaced by an ion of reduced mobility (further to the right in the representation), formed by the reaction of vapour emitted by the board with reactant ions in the instrument. This characteristic feature increases in intensity and then falls as a further prominent ion is formed (Figure 3).

Example 2

Example 1 was repeated but this time with a resistor in place of the printed circuit board. In a first experiment, the resistor was heated from 50 to 100°C and in a second experiment, a temperature range of from 90 to 140°C was used. Significant changes in the negative ion spectra (Figures 4 and 5 respectively) were recorded.

The sensitivity of this technique is clear from this example, as resistors do not generally emit volatile materials.

Claims

1. A method for detecting gases or vapours emitted from materials under conditions at which there is a risk of the onset of fire, said method comprising sampling gas from the region of the material using an ion mobility spectrometer, detecting the ion peak of volatilised material.

2. A method according to claim 1 which is effected in a data processing or computer facility, a telephone exchange, a space station, or an industrial plant.

3. A method according to claim 1 or claim 2 wherein sampling is effected continuously.

4. A method according to claim 1 or claim 2 wherein sampling is effected at predetermined time intervals.

5. A method according to any one of the preceding claims wherein the ion mobility spectrometer is connected to an alarm system.

6. A method according to claim 5 wherein the alarm is triggered when an ion peak reaches a predetermined intensity level.

7. A method according to claim 5 wherein the alarm is triggered when any ion peak increases significantly over a period of time.

8. A method according to any one of claims 5 to 7 wherein the alarm is triggered when a feature characteristic of thermal degradation is detected.

9. A method according to any one of the preceding claims wherein the ion mobility spectrometer is set to detect volatile material released from an electrical component.

10. A method according to claim 9 wherein the electrical component is a printed circuit board or a resistor.

11. Apparatus for detecting a heightened fire risk in an environment using the method as claimed in any one of claims 1 to 10.

12. An ion mobility spectrometer adapted such that it is able to detect increases in the amounts of gases or vapours emitted from materials present in a particular environment, under conditions at which there is a heightened risk of the onset of fire.

13. An ion mobility spectrometer for use in a method according to any one of claims 1 to 10.

14. An ion mobility spectrometer when used in a method according to any one of claims 1 to 10.

15. The use of an ion mobility spectrometer for the detection of a heightened risk of fire in an environment.

16. The use according to claim 15 wherein controls of the ion mobility spectrometer are arranged so that it is able to detect increases in the amounts of gases or vapours emitted from materials present in the environment under conditions at which there is a risk of the onset of fire.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

Fire Detection Method

The present invention relates to a method for the detection of overheating of materials in particular electrical equipment, which precedes the onset of fire, as well as to apparatus for use in the method. Thus the invention is useful in providing advance warning of conditions likely to lead to fire so that preventative action can be taken.

Early warning fire detectors often rely on the detection of smoke particles to trigger an alarm. At this stage, fire is imminent if not already underway and so it is generally too late for preventative action.

Methods for the early detection of fire based upon the vapour detection have also been described. These have potential to provide advanced warning of an imminent fire. These chemical sensing techniques are often based on chemical coatings which interact with the outgassing vapours either through a chemical reaction (USP 5065140) or adsorption. In the former case, the detector lacks versatility in that it reacts only to the vapour of interest. The latter method lacks specificity and requires considerable signal processing effort.

Ion mobility spectrometers are well known in the detection of chemical warfare agents, explosives, propellants, and industrial pollutants. The principles by which they operate and the design of spectrometers are described for example by W. Carr (Ed). "Plasma Chromatography", Plenum Press, London, 1984, and Turner et al., Trends in Analytical Chemistry, 13, 7 (1994) 275-280. In essence, an ion mobility spectrometer consists of an ionisation region coupled to an ion drift tube via a shutter grid. A sample is introduced into the ionisation region together with a carrier gas (such as air), for example using a suction pump. In the ionisation region, the carrier gas molecules (as well as any sample) are ionised

by beta radiation from a Ni-63 radioactive source, or other methods such as corona discharge or photoionisation. Reactant ions are produced from the carrier gas (such as air) which react with the sample gas, generally in a complex manner, so as to result in product ions. Under the influence of an applied electric field, reactant and product ions are extracted from the ionisation region into the ion drift region. In the ion drift region, the ions separate due to their different mobilities determined by their size, charge and polarisability. They are collected at a collector electrode where they are neutralised, and so generate an electric current that can be measured. Data is generated at a rapid rate. Repeat scans are suitably averaged to improve the signal to noise ratio.

The spectrometer can be arranged to detect either positive or negative ions by reversal of the voltages.

The present invention provides a method for detecting gases or vapours emitted from materials under conditions at which there is a risk of the onset of fire, said method comprising sampling gas from the region of the material using an ion mobility spectrometer, detecting the ion peaks of volatilised material.

The advantages of the use of ion mobility spectrometry in this application are associated with its extreme sensitivity and selectivity. The spectrometer can be pre-set, by controlling the potentials applied to the drift region for example, so as to detect selected target gases which are emitted during outgassing through heating in any specific environment. The selectivity of the device means that it could be applied to a variety of different environments. However, it will be particularly useful in high technology environments, such as data processing and computer facilities, telephone exchanges, space stations, industrial plants especially chemical plants

or plants which deal with inflammable materials, where the risk of fire as a result of overheating devices and in particular electrical components is high, and the consequences of such a fire are extreme in economic terms at least.

Sampling can take place either continuously or at intervals, for example at pre-set intervals. Preferably, the sampling will be carried out continuously, as this allows an increasing signal, produced as a result of increased outgassing of a particular gas from the materials, for example as the temperature rises, to be detected against background noise levels.

The spectrometer may be connected to a warning or alarm system that may be triggered automatically, using various predetermined parameters. For example, if a signal peak reaches a particular intensity, this may trigger the alarm. An alternative, particularly suitable with continuous monitoring, would be to arrange for the alarm to be triggered when any signal peak increases significantly over a period of time. This may be indicative of a rise in temperature of the component that gives rise to the particular gas or vapour.

The alarm may be connected to the detection of features characteristic of thermal degradation and not just simple over-heating of components. This would ensure that only potentially serious situations resulted in an actual alarm, reducing false positives to a minimum.

The levels and the parameters used to trigger the alarm will vary depending upon the particular circumstances in which the spectrometer is being employed. Again, these can be determined using routine methods and the control systems designed appropriately.

There is no need to know or analyse the materials which are emitted, provided it can be ensured that at least some of these fall within the detection range set on the ion mobility spectrometer. This can be done by routine methods. For example, one or more representative components present in the particular environment to be monitored can be heated under safe test conditions and the signal generated as a result of the emission of material monitored. The detection range of the ion mobility spectrometer can then be adjusted to ensure a signal is generated under these conditions.

The spectrometer will be pre-set to detect either positive or negative ions depending upon the nature of the signal in each case. Selection of the most sensitive signal in each particular case can be determined, again by routine methods.

Many solid materials that release volatile material when heated, but in particular are electrical components such as printed circuit boards, resistors and lacquer-coated materials. The spectrometer will suitably be set to detect vapours emitted from such components.

Available ion mobility spectrometers are convenient to use in that it is small and hand-held. For use in the context of the invention however, size and portability may be less critical. The spectrometer may be installed in the environment on a permanent basis. It would not, under these circumstances be required to be as robust as a device which is intended, for example to be carried onto a battle-field. This may result in cost savings in the spectrometer itself.

In a further aspect the invention provides apparatus for detecting a heightened fire risk in an environment using the method as described above.

In particular, the apparatus will comprise an ion mobility spectrometer. The spectrometer is suitably adapted such that it is able to detect increases in the particular gases or vapours emitted from materials present in the particular environment in which it is placed, under conditions at which there is a heightened risk of the onset of fire. In particular, the controls of the device will be pre-set so that they are able to detect specific volatile materials likely to be emitted from materials present in the particular environment, which presents a potential fire hazard.

The precise settings of the controls of the spectrometer will vary depending upon the particular environment being monitored and can be determined by the skilled person using routine methods. Typically the electric field applied to the drift tube of the device will be in the range of from 150 to 350V/cm, more usually from 200 to 300V/cm and often at about 250V/cm. The frequency of spectrometer readings necessary to provide a rapid, detectable signal will depend to some extent, on the ion drift times of the particular volatile materials being detected. Generally, these are less than 20ms, and so spectra may be gathered at the rate of between 40 to 60 Hz, for example at about 50Hz.

Thus in a particular embodiment of the invention, there is provided an ion mobility spectrometer for use, or when used, in the method described above.

Yet a further aspect of the invention provides the use of an ion mobility spectrometer for the detection of a heightened risk of fire in an environment. More particularly, there is provided, the use of an ion mobility spectrometer in the detection of gases or vapours emitted from materials under conditions at which there is a risk of the onset of fire.

The invention will now be particularly described by way of example with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a schematic diagram of an ion mobility spectrometer;

Figure 2 shows the positive ion mobility spectra for a heated lacquer-coated printed circuit board at temperatures of from 50 to 85°C;

Figure 3 shows the positive ion mobility spectra for a heated lacquer-coated printed circuit board at temperatures of from 85 to 105°C;

Figure 4 shows the negative ion mobility spectra for a resistor heated to 50 to 100°C; and

Figure 5 shows the positive ion mobility spectra for a resistor heated to 50 to 100°C.

The illustrated device in Figure 1 comprises an inlet system comprising a heated nozzle (1) and a silicon rubber membrane (2). Gas sample is admitted through the inlet system as a result of the action of a diaphragm pump (3) operated by a motor (4). Sample transfers into an ionisation section (5) where a nickel-63 ion source generates the ions. A pulse of ions (generally about 0.2ms) is admitted into a drift tube section (6) by manipulation of the potentials on a grid assembly (7). The drift tube (6) is typically about 4cm long with an electric field of 250V/cm. Ions pass to a collector electrode (8), where they are neutralised, generating a current which is passed to a microprocessor (9), which generates a signal, if necessary after amplification. The signal may be passed to a display assembly (10).

In general ion drift times are less than 20ms, and so spectra may be gathered at the rate of say 50Hz.

Example 1

A lacquer coated printed circuit board was heated from 50 to 105°C in the vicinity of an ion mobility spectrometer that was operational throughout. At the start of the heating process, the positive reactant ion peak (i.e. that produced as a result of the ionisation of air), is the major feature of the spectrum (see Figure 2 – trace at the back of the representation). As the printed circuit board was heated, this peak is replaced by an ion of reduced mobility (further to the right in the representation), formed by the reaction of vapour emitted by the board with reactant ions in the instrument. This characteristic feature increases in intensity and then falls as a further prominent ion is formed (Figure 3).

Example 2

Example 1 was repeated but this time with a resistor in place of the printed circuit board. In a first experiment, the resistor was heated from 50 to 100°C and in a second experiment, a temperature range of from 90 to 140°C was used. Significant changes in the negative ion spectra (Figures 4 and 5 respectively) were recorded.

The sensitivity of this technique is clear from this example, as resistors do not generally emit volatile materials.

Claims

1. A method for detecting gases or vapours emitted from materials under conditions at which there is a risk of the onset of fire, said method comprising sampling gas from the region of the material using an ion mobility spectrometer, detecting the ion peak of volatilised material.

2. A method according to claim 1 which is effected in a data processing or computer facility, a telephone exchange, a space station, or an industrial plant.

3. A method according to claim 1 or claim 2 wherein sampling is effected continuously.

4. A method according to claim 1 or claim 2 wherein sampling is effected at predetermined time intervals.

5. A method according to any one of the preceding claims wherein the ion mobility spectrometer is connected to an alarm system.

6. A method according to claim 5 wherein the alarm is triggered when an ion peak reaches a predetermined intensity level.

7. A method according to claim 5 wherein the alarm is triggered when any ion peak increases significantly over a period of time.

8. A method according to any one of claims 5 to 7 wherein the alarm is triggered when a feature characteristic of thermal degradation is detected.

9. A method according to any one of the preceding claims wherein the ion mobility spectrometer is set to detect volatile material released from an electrical component.

10. A method according to claim 9 wherein the electrical component is a printed circuit board or a resistor.

11. Apparatus for detecting a heightened fire risk in an environment using the method as claimed in any one of claims 1 to 10.

12. An ion mobility spectrometer adapted such that it is able to detect increases in the amounts of gases or vapours emitted from materials present in a particular environment, under conditions at which there is a heightened risk of the onset of fire.

13. An ion mobility spectrometer for use in a method according to any one of claims 1 to 10.

14. An ion mobility spectrometer when used in a method according to any one of claims 1 to 10.

15. The use of an ion mobility spectrometer for the detection of a heightened risk of fire in an environment.

16. The use according to claim 15 wherein controls of the ion mobility spectrometer are arranged so that it is able to detect increases in the amounts of gases or vapours emitted from materials present in the environment under conditions at which there is a risk of the onset of fire.

Fig.1.

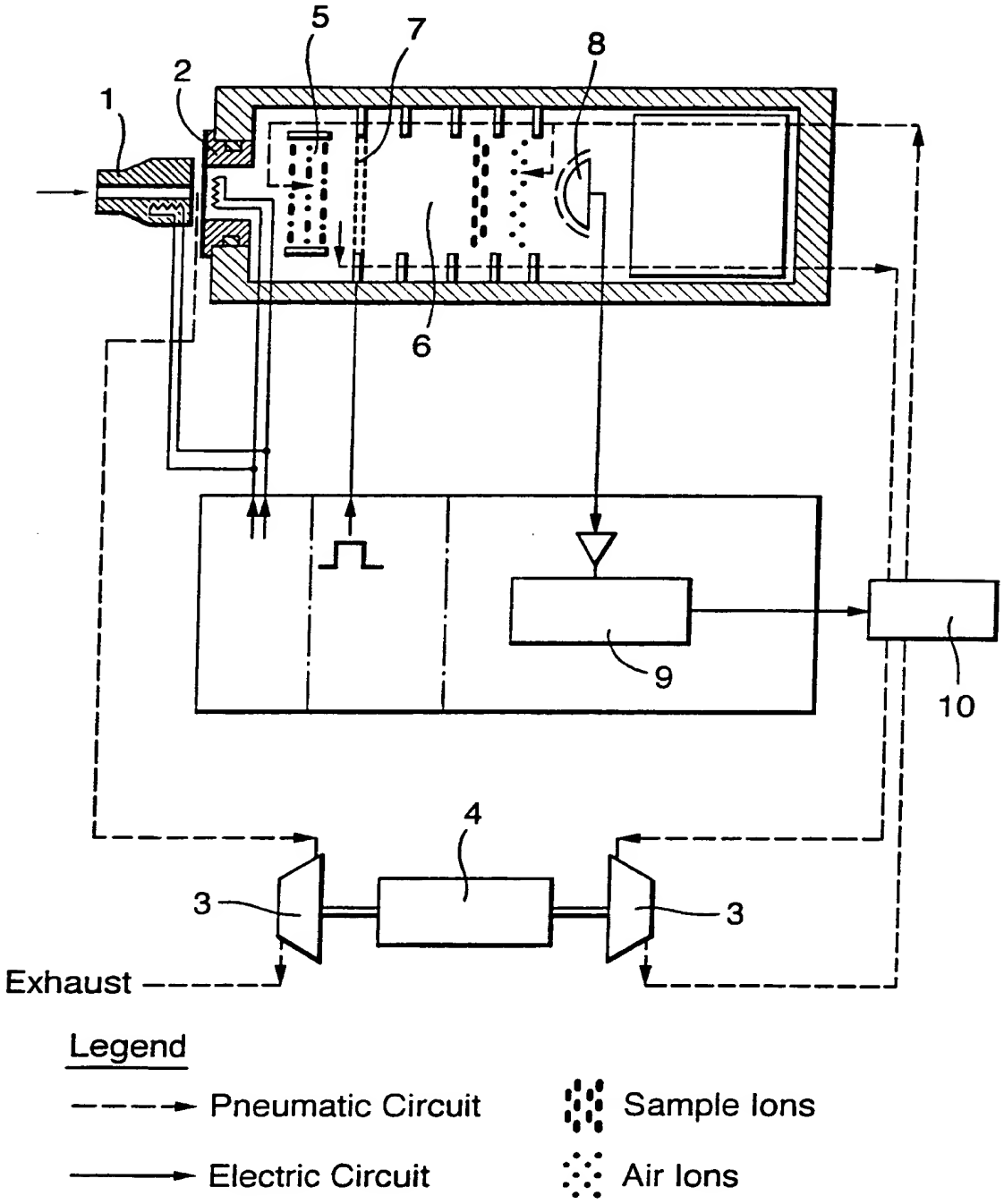

5
7
8
2
1
6
9
10
4
3
3
Exhaust
Legend
Pneumatic Circuit
Electric Circuit
Sample Ions
Air Ions

Fig.2.

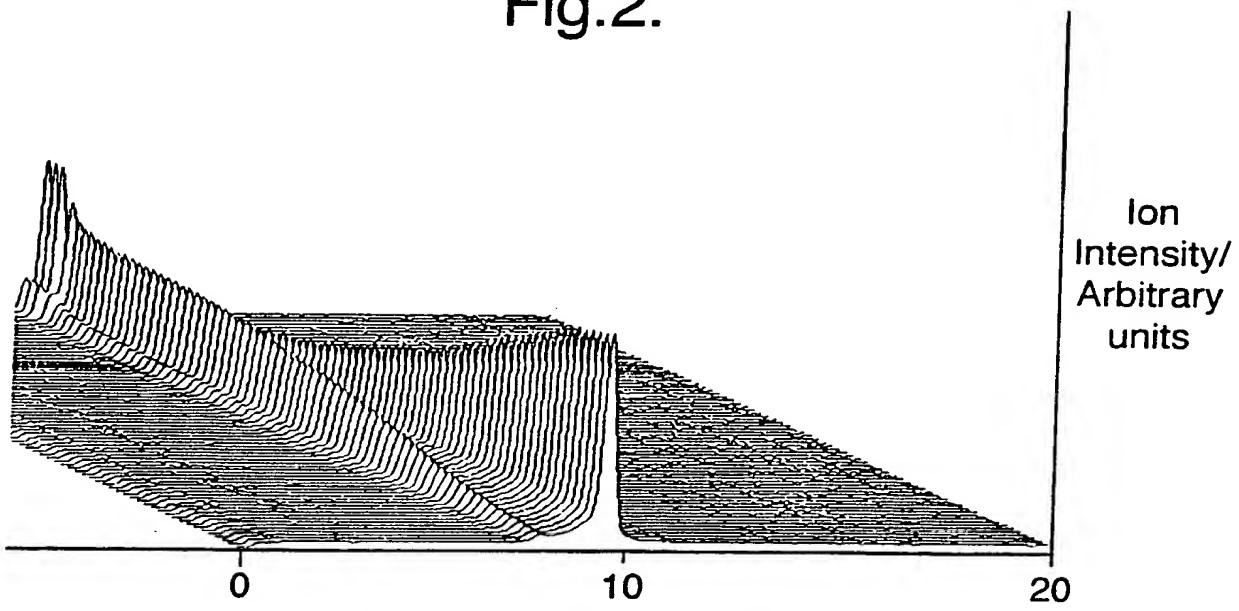

Ion
Intensity/
Arbitrary
units
0
10
20
Ion drift time / ms

Fig.3.

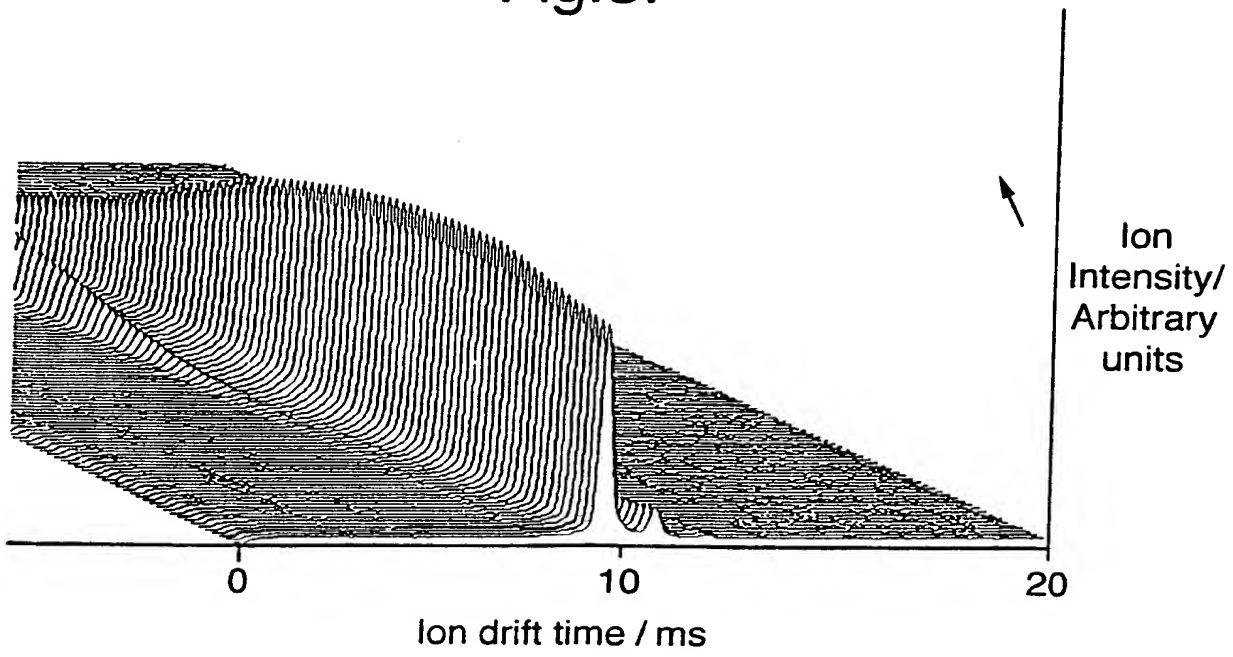

Ion
Intensity/
Arbitrary
units
0
10
20
Ion drift time / ms

Fig.4.

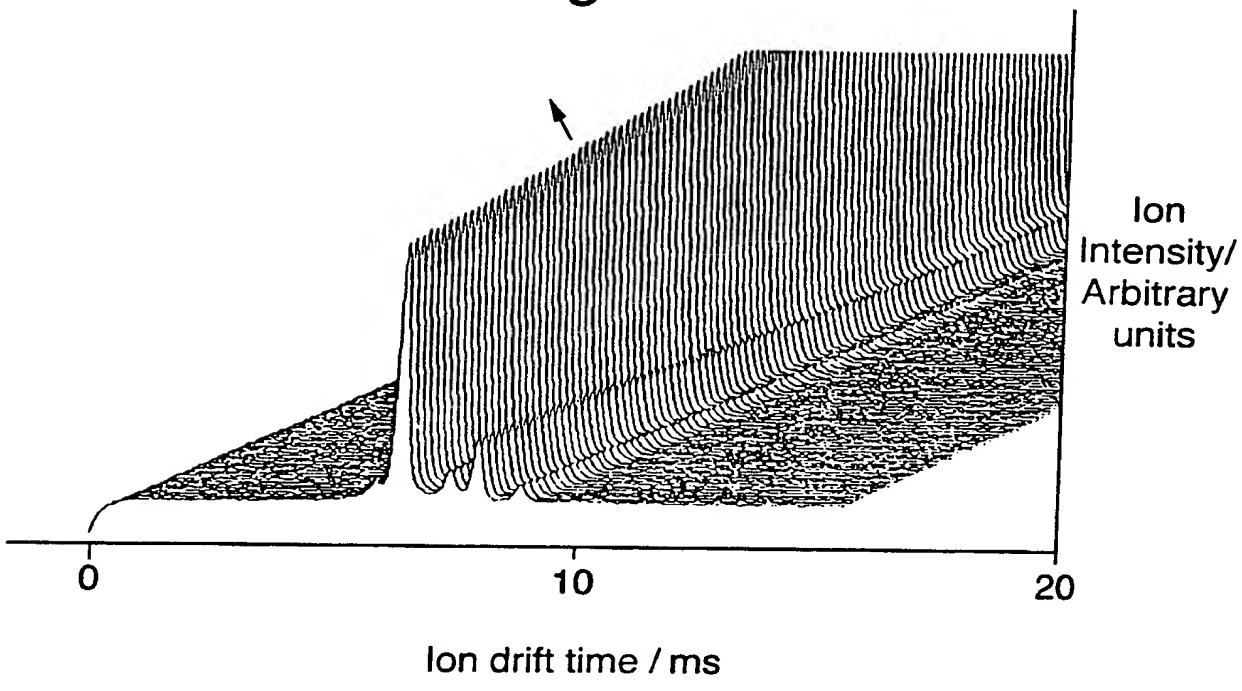
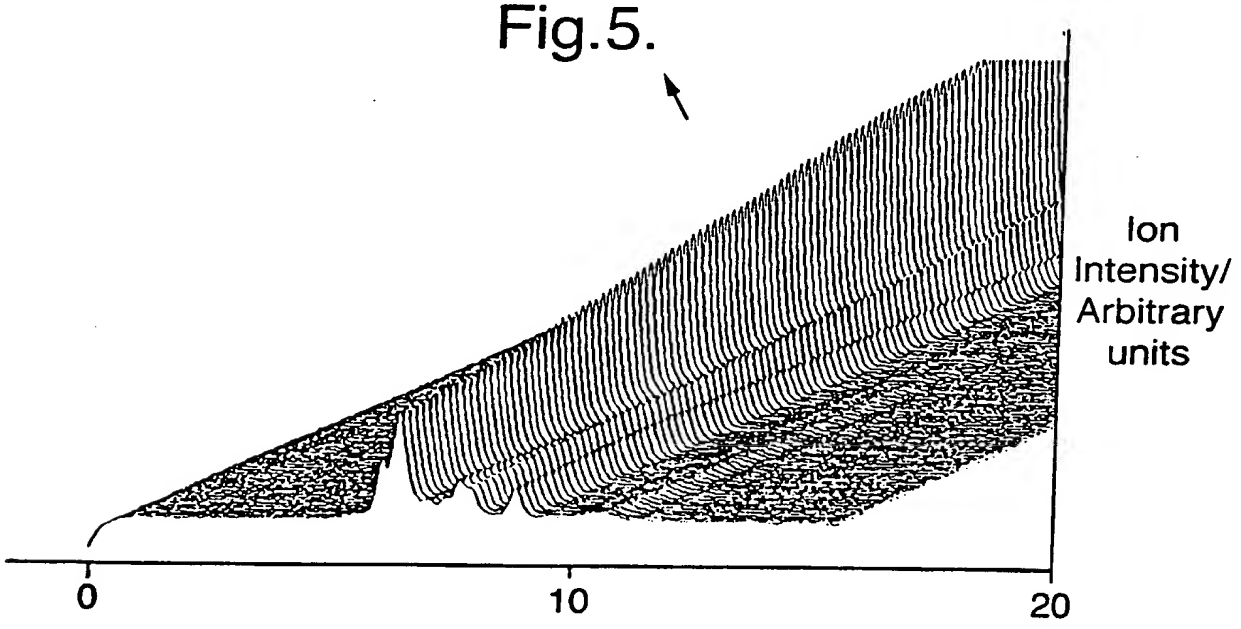

Ion
Intensity/
Arbitrary
units
0
10
20
Ion drift time / ms

Fig.5.


Ion
Intensity/
Arbitrary
units
0
10
20
Ion drift time / ms

INTERNATIONAL SEARCH REPORT

Inter. ional Application No
PCT/GB 00/00210

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G08B17/117 G01N27/64 G08B17/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G08B G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 691 783 A (STERN GEOFFREY S ET AL) 8 September 1987 (1987-09-08) the whole document	1,2
A	EP 0 795 749 A (BRUKER SAXONIA ANALYTIK GMBH) 17 September 1997 (1997-09-17) the whole document	1,2,5,6, 12-16
A	US 5 294 794 A (DAVIES DAVID K) 15 March 1994 (1994-03-15) the whole document	1,12
A	US 5 405 781 A (DAVIES JOHN H ET AL) 11 April 1995 (1995-04-11) the whole document	1,12

-/—

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 April 2000	12/04/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax (+31–70) 340–3016	Kelperis, K

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/GB 00/00210

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 162 652 A (COHEN MARTIN J ET AL) 10 November 1992 (1992-11-10) the whole document	1,12
A	EP 0 401 861 A (RES CORP TECHNOLOGIES INC) 12 December 1990 (1990-12-12) the whole document	1,12

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter. nal Application No
PCT/GB 00/00210

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4691783 A	08-09-1987	NONE	
EP 0795749 A	17-09-1997	DE 19609582 C	28-05-1997
		US 5968837 A	19-10-1999
US 5294794 A	15-03-1994	NONE	
US 5405781 A	11-04-1995	CA 2132607 A	22-03-1995
US 5162652 A	10-11-1992	NONE	
EP 0401861 A	12-12-1990	US 4987767 A	29-01-1991
		AT 153131 T	15-05-1997
		AU 633582 B	04-02-1993
		AU 5690590 A	13-12-1990
		CA 1329494 A	17-05-1994
		CA 2018697 A	09-12-1990
		DE 69030686 D	19-06-1997
		DK 401861 T	03-11-1997
		ES 2102355 T	01-08-1997
		GR 3024358 T	28-11-1997
		IL 94684 A	29-12-1994
		IL 107672 A	15-03-1995
		JP 2119373 C	06-12-1996
		JP 3087629 A	12-04-1991
		JP 8033338 B	29-03-1996
		JP 2610118 B	14-05-1997
		JP 7209151 A	11-08-1995
		KR 9409049 B	29-09-1994
		US 5465607 A	14-11-1991
		US 5585575 A	17-12-1996
		US 5345809 A	13-09-1994
		AT 182406 T	15-08-1999
		AU 679387 B	26-06-1997
		AU 3063495 A	09-11-1995
		AU 7032291 A	18-07-1991
		CA 2070648 A	09-06-1991
		CA 2229011 A	09-06-1991
		DE 69033217 D	26-08-1999
		DE 69033217 T	09-12-1999
		EP 0502998 A	16-09-1992
		EP 0881479 A	02-12-1998
		EP 0881482 A	02-12-1998
		EP 0881480 A	02-12-1998
		EP 0905501 A	31-03-1999
		ES 2134192 T	01-10-1999
		IE 80621 B	21-10-1998
		IL 96605 A	21-10-1994
		JP 9126964 A	16-05-1997
		JP 9126965 A	16-05-1997
		JP 9126966 A	16-05-1997
		JP 2814304 B	22-10-1998
		KR 171421 B	01-05-1999
		WO 9109307 A	27-06-1991
		US 5109691 A	05-05-1992

US 098896390DP1

Creation date: 01-13-2004
Indexing Officer: MZHOU - MEI ZHOU
Team: OIPEBackFileScanning
Dossier: 09889639

Legal Date: 10-09-2001

No.	Doccode	Number of pages
1	FOR	38
2	FOR	16
3	FOR	2
4	FOR	6
5	FOR	26

Total number of pages: 88

Remarks:

Order of re-scan issued on .....